

## **Putting It all Together: Aggregating Benefits, Selling to Stakeholders The Benefits of Zero Energy Homes Reach Far Beyond Homeowners**

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### PURPOSE

The purpose of this paper is to identify and demonstrate the value green near-Zero Energy Homes offer to multiple stakeholders including: homebuyers, homebuilders, electric utilities, and local jurisdictions. On a community scale, the benefits of green near-Zero Energy Homes are as valuable for local jurisdictions and utilities as they are for the homeowner. If the homebuilding industry can successfully market this value to local jurisdictions and electric utilities, the costs can be shared with the builder and homebuyer, thereby making green near-Zero Energy Homes more affordable and commonplace.

### ABSTRACT

The U.S. Department of Energy's Building America program aims to achieve marketable, cost-effective net-Zero Energy Homes by 2020. Over the course of a year, a net-Zero Energy Home produces and much power as it consumes. Building America's focus has been on creating value for the homeowner; so utility bill savings offset the increased cost of the home's energy saving features. However, evidence is beginning to accumulate demonstrating the value these homes have for additional stakeholders, such as electric utilities, local jurisdictions, and builders. By communicating these benefits, the cost of green-near Zero Energy Homes can be shared for the benefit of all parties. If the homebuilding industry can successfully market this value to local jurisdictions and electric utilities, the costs can be shared with the builder and homebuyer, thereby making green near-Zero Energy Homes more affordable and commonplace.

This paper highlights the major stakeholder benefits of community scale green-near Zero Energy Home projects and examples of stakeholder cost-sharing.

### 1. INTRODUCTION

The U.S. Department of Energy's Building America program goal of cost-effective, marketable net-Zero Energy Homes by 2020 is within sight. The Building Industry Research Alliance (BIRA) is one of six teams working with the Department of Energy and National Labs to make this goal a reality. Based in California, BIRA has worked with regional and national builders to construct over 1,500 Zero Energy Homes in the past five years. Today's near-Zero Energy Homes (ZEHs) reduce energy use by at least 50% through energy efficiency and solar energy technologies. The 50% savings level is largely determined by the current limitations for determining cost-effectiveness:

Will monthly utility bill savings positively offset the portion of monthly mortgage payment linked to ZEH features, thereby creating positive monthly cash flow?

In California with energy efficiency rebates and photovoltaic buy-downs it is possible to reach positive cash flow using currently available designs and technologies. The incentives have made it possible for profit-driven production builders to build Zero Energy Communities.

As the ZEH concept has matured and more communities have been built in California, evidence is beginning to accumulate demonstrating the value these homes have on the environment, utility bills, electric utility peak, builder

marketing, and jurisdictional infrastructure. Through engaging stakeholders and measuring this value, then communicating the value to other markets, ZEH communities can be built throughout the country.

The key for ZEH cost-effectiveness is to understand the local conditions in which a ZEH community will be built and design a strategy to quantify and communicate value for stakeholders. Just as designing a Zero Energy Home considers local climatic issues; a ZEH community financing effort must consider local issues when determining who benefits and how.

Through engaging stakeholder needs, Zero Energy Communities will become increasingly cost effective and efficient, offering benefits for all stakeholders. Utility rebates and solar buy-downs are just the beginning, its time to put the pieces of the puzzle together

## 2. BACKGROUND

Much of the supporting evidence for this paper comes from a Building America case study comparing standard practice homes and near-Zero Energy Homes.

In 2004 and 2005, Premier Homes and Cresleigh Homes undertook a business agreement to divide the development of a plot of land in Rancho Cordova, CA. Rancho Cordova is located on the east edge of Sacramento. BIRA, working closely with key partners, has collected and analyzed electricity (provided by SMUD) and gas data (provided by PG&E), analyzed buyer demographics (studied and reported by RAND), and evaluated the efficacy of ZEH system components. The resulting community consists of 95 Premier near-Zero Energy Homes on the west side of the property, and 98 Cresleigh homes on the east. This large scale study, including roughly 100 homes in each community, examined the differences in energy consumption, buyer demographics, peak electricity demand, homebuyer benefits, and builder benefits from the construction, marketing, and operation of a large-scale near-Zero Energy community. It was found that near-Zero Energy Homes benefit parties beyond the homeowner.

The builder received local and national publicity selling faster than the standard community next door. The local utility, the Sacramento Municipal Utility District, realized average peak period electricity savings of 70% compared to the standard neighboring community homes. These findings, combined with other research, demonstrate the ability of Zero Energy Homes to benefit parties beyond the homeowner.

This paper will use the Premier Gardens case study as a framework for displaying the benefits of these homes, along with additional case studies and programs.<sup>1</sup>

To begin, the benefits of Zero Energy Homes will be discussed in reference to the stakeholders valuing these benefits. Today's high-performance Zero Energy Home is designed and cost-optimized based on local climatic, code, and building practice issues. For the purpose of this paper, only production scale Zero Energy Homes will be discussed.

The rationale for discussing only large-scale home developments, 50 homes or more, is that the aggregated benefits of these homes are large enough to be important to stakeholders beyond the homeowner.

### 2.1 Today's Zero Energy Home

Today's Zero Energy Home reduces energy bills by 40-70% through energy efficiency and solar energy technologies. By introducing energy savings features first, the cost to build Zero Energy Homes is reduced. All applicable energy efficiency features are added before solar energy, (photovoltaic panels "PV"), to optimize energy savings with as little incremental cost as possible.

### 2.2 Premier Gardens and Cresleigh Rosewood

The homes built in both of these developments are approximately the same size. The energy features are different in several notable ways. Premier Homes, working with support and encouragement from SMUD and BIRA, developed the first full-scale near-Zero Energy Community in the Sacramento area on their half of the development. On the other half, Cresleigh built homes participating in the SMUD Advantage Program intended to reduce summer cooling by 30% and otherwise meeting the California Title 24 requirements in effect at the time of construction.

The Premier Gardens' homes are significantly more energy-efficient and include a 2.0 kW AC photovoltaic (PV) system on each house. The table below compares the as-built energy features of the two developments

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<sup>1</sup> For the complete Premier Gardens case study, please see the ASES Solar 2007 paper titled: Premier Gardens & Cresleigh Rosewood: A Zero Energy Community Case Study

**TABLE 1: AS BUILT ENERGY FEATURES**

Community	Premier Gardens	Cresleigh Rosewood
<b>Energy Program</b>	<b>ComfortWise</b>	<b>SMUD Advantage</b>
	2,248	2,384
<b>Square Footage of Each House Plan</b>	1,846	2,024
	1,625	2,000
	1,503	1,850
	1,285	1,720
		1,610
<b>PV</b>	<b>2kW AC GE</b>	<b>None</b>
<b>AC</b>	<b>14 SEER</b>	<b>10 SEER</b>
<b>Heating</b>	<b>92% AFUE</b>	<b>80% AFUE</b>
<b>Water Heating</b>	<b>Tankless 0.82EF</b>	<b>40 Gallon 0.60EF</b>
<b>Ceiling</b>	<b>R-38</b>	<b>R-30</b>
<b>Walls</b>	<b>R-13 + 1in foam w/Stucco</b>	
<b>Windows</b>	<b>Vinyl Low E</b>	
<b>Lighting</b>	<b>Fluorescent</b>	<b>Incandescent</b>
<b>Ducts</b>	<b>Sealed, Tested, Buried</b>	<b>Sealed, Tested</b>

**3. ZEH BENEFITS: DEMONSTRATING VALUE**

**3.1 Homeowner Benefits**

The benefits of the well-built near-Zero Energy Homes are numerous. A professionally engineered and tested HVAC system provides better comfort and indoor air quality for occupants. Low-emissivity windows provide added comfort and protect furniture and fabric from fading and wear. Better insulation and testing provide more even temperatures throughout the home and better sound insulation from outside noise. All the ZEH features provide 44% whole house energy savings over a similar home built to the then current SMUD Advantage Home requirements.

It has been shown that Zero Energy Homes can have higher resale values. According to a National Renewable Energy Laboratory Technical Report, ZEHs built by SheaHomes in San Diego resold for 16.6% more than a comparable community.<sup>2</sup>

**TABLE 2: ENERGY BILL SAVINGS**

<b>Energy Bill Savings</b>				
Community	Avg Gas Bill	Avg Electric Bill	Total Energy Bill	Yearly Energy Bill
Premier	\$32.32	\$32.89	\$65.21	\$782.52
Cresleigh	\$46.14	\$68.29	\$114.43	\$1,373.16
Savings (\$)	\$13.82	\$35.40	\$49.22	<b>\$590.64</b>
Savings (%)	30%	52%	<b>43%</b>	43%
<b>Premier Residents save 43% on energy bills amounting to \$590.64/year</b>				

Unfortunately there have not been enough homes resold in Premier Gardens or Cresleigh Rosewood to judge whether the near-ZEHs will increase in value relative to non-ZEHs. As more homes are resold, this question can be answered.

As Table 2 displays, the energy bills savings for Premier Gardens homeowners are close to \$60 a month. Considering, Premier buyers paid a similar price for their homes as compared to Cresleigh, this makes the cost of ownership lower.

**3.2 Builder Benefits**

Premier Homes first near-Zero Energy community, Premier Gardens, was an overwhelming success story. Not only did the homes sell faster than expected, but Premier Homes received valuable local and national media coverage including a segment on CNBC highlighting the utility bill savings of the Premier homeowners. Successful projects like Premier Gardens encourage other builders to take notice of the Zero Energy Home concept. As a result of the success at Premier Gardens, Premier Homes has continued to build Near Zero Energy Communities. In 2007, Premier Homes will build their most energy efficient community yet, Premier Lakeside, offering significantly higher levels of efficiency compared to Premier Gardens, again as standard in each of the homes.

According to John Ralston, Premier Homes VP of Sales and Marketing, and a driving force behind the Premier Gardens project, Premier Gardens received more media attention than was ever expected and sales were remarkable. Although brisk sales would be expected during the 2004-2005 hot housing market, Premier Gardens began construction later and sold out earlier than neighboring Cresleigh Homes.

There have been other examples of Zero Energy Communities selling faster than the competition. Clarum Homes constructed a near-Zero Energy community in Watsonville, California in 2003. In addition to apartments,

<sup>2</sup> “A Comparative Market and Utility Analysis of New High-Performance Homes in San Diego” B.C. Farhar and T.C. Coburn

Vista Montana included 257 new single-family attached and detached homes making it the largest Zero Energy Community in the nation. The homes sold faster than neighboring communities, and received similar publicity to Premier Gardens. In 2006, Clarum won California's Governors Award for Environmental Leadership.

In 2006, Grupe Homes constructed a Zero Energy Community outside of Sacramento, California. Grupe's community, Carsten Crossings, is part of the larger master planned development Whitney Ranch. Despite being the furthest community from the entrance, Grupe has sold more homes than all 8 of the other communities within Whitney Ranch.

The evidence is mounting that in hot and cool housing markets the value of ZEH differentiation and value sells homes faster.

Through combining energy efficiency and solar-electric systems, near-ZEH builders are able to successfully market homes achieving fast sales, garnering media attention, and achieving high levels of public recognition and accolades.

### 3.3 Electric Utility Benefits

System peak demand is a serious concern for SMUD, many other California utilities, and utilities across the country. When speaking with Mike Keesee, Wade Hughes, or Bruce Cenicerros at SMUD, BIRA quickly learned their main objective: cut peak demand, more specifically cut residential cooling demand. Wade Hughes said "It's all about A/C."<sup>3</sup> As seen in Figure 1, the control non-ZEH's kW demand follows a similar curve to SMUD's system demand.

To study the impacts that near-ZEHs have on peak, SMUD designed a monitoring experiment using the Premier Gardens and Cresleigh Rosewood communities. SMUD set up monitoring equipment to gather 15-minute data for a statistically significant 18 homes in each community to compare peak performance. The heat storm experienced July 2005 in Sacramento is the best opportunity to evaluate peak performance between communities. During July 2005, the average daily high was 98 degrees, and low was 65 degrees, the highest on record.

SMUD set a new system peak demand July 15<sup>th</sup>, 2005 at 5pm that was 5% above the previous system high.

Peak demand data compiled from the near-ZEH and adjacent non-ZEH communities show that near-ZEHs can have a significant impact on a home's peak demand. Figure 1 shows the average 15-minute interval peak demand

from the Premier Garden's ZEHs and adjacent non-ZEHs for the month of July. As the graph shows, the near-ZEH peak demand was demonstrably lower than the adjacent, non-ZEHs'. During SMUD's peak, 12pm-7pm, the near-ZEH's used an average of 73% less electricity than the non-ZEHs during July 2005. This is especially significant as the non-ZEHs were SMUD Advantage Homes designed to use at least 30% less cooling energy than homes built to the Title-24 cooling energy standards. As Figure 1 displays, approximately half the peak savings are a result of efficiency, while PV generates the other half. For this project, the energy efficiency features were five times less expensive than the PV panels.

It is also significant that 5 of the 18 near-ZEH PV systems face east, thus providing little or no electricity during the afternoon and evening peak periods. As SMUD's system peak occurred at 5pm, westerly-facing PVs would have provided the most electricity back to the grid at this time. An analysis was done to determine the impact of all westerly-facing PVs on Premier's near-ZEHs. This analysis shows that had the Premier Gardens development been designed to maximize westerly-facing PV's, the net grid load could be shifted almost three hours. Additionally, the average demand at 5pm would have reduced from 1.3 kW as built, to 0.75 kW with all westerly facing PV.

The Premier Gardens project has been as successful for SMUD as it has been for Premier Homes. The demonstrated ability of the near-ZEHs to cut peak electrical demand significantly over Cresleigh's SMUD Advantage Homes delighted SMUD officials. The success at Premier has prompted SMUD to create a Zero Energy Homes program to begin to leverage the peak shaving power of ZEHs.

Mike Keesee wrote, "In the past few years, Sacramento has seen record numbers of new homes built. This boom in new home construction is leading to increased demand for electricity, raising utility bills and taxing local electrical utility systems. Central air conditioning is a standard feature in all new homes built in Sacramento and a major factor in SMUD's peak electrical demand growth. SMUD is participating in the BAP because the District believes ZEH can reduce its peak demand while dramatically reducing new homeowners' utility bills."<sup>4</sup> In a personal interview, Mike Keesee told BIRA that the Premier Garden's project was "precedent setting" and that an important goal was to "shift demand."<sup>5</sup> Bruce Cenicerros, SMUD's Principal Planner for New Construction Programs,

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<sup>3</sup> Personal Interview with Wade Hughes November 7, 2006.

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<sup>4</sup> Draft article, PREMIER GARDENS – SACRAMENTO'S FIRST ZERO ENERGY HOME COMMUNITY, by Mike Keesee, to be submitted to Home Energy.

<sup>5</sup> Personal Interview with Mike Kessee November 2006.

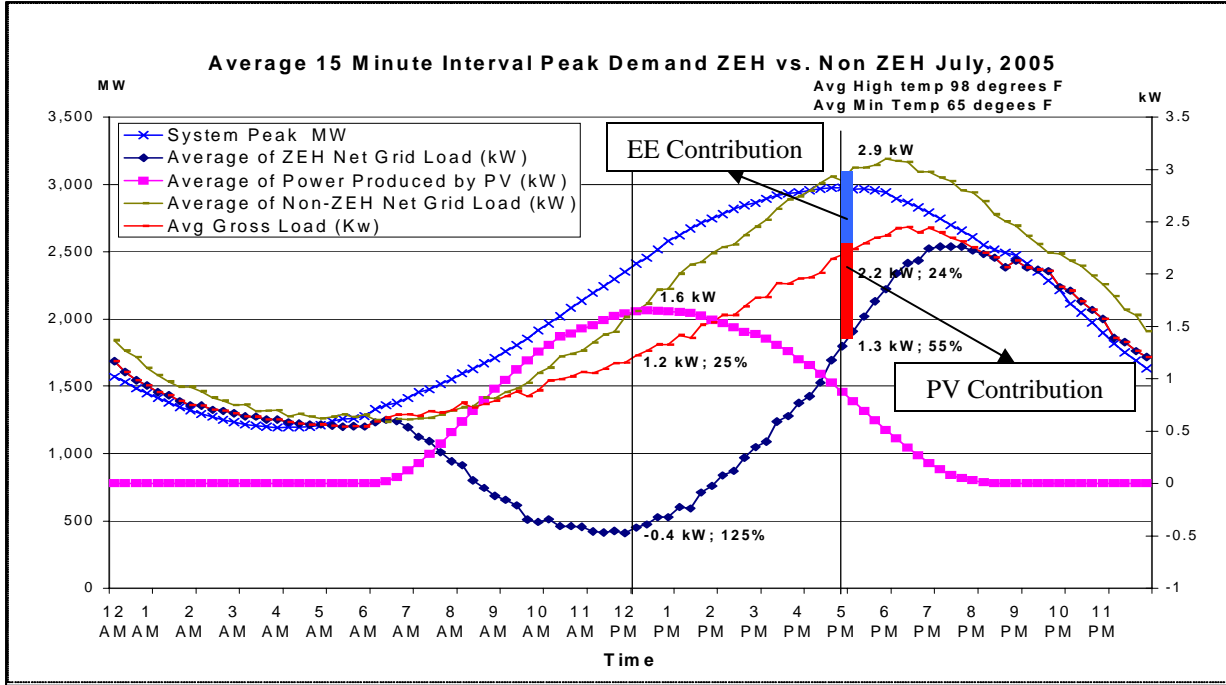


Fig. 1: Peak Electricity Demand for Premier and Cresleigh Homes July 2005.



Fig. 2: Premier Gardens community showing PV systems on roofs (courtesy of GE).

believes SMUD needs to focus more on peak both for grid reliability and to reduce the marginal costs of peak electricity. SMUD's need to shift peak demand is similar to most electric utilities. At peak periods, electricity is expensive to produce, buy, and distribute. Large capital investments are needed to provide electricity for very few hours throughout the year. The ability to reduce peak demand to off-peak periods, and flatten the utility's load shape can significantly reduce the capital investments and marginal costs of energy creating lower prices for all consumers.

### 3.4 Local Jurisdictional Benefits

The Building Industry Institute has developed a builder-friendly program to address jurisdictional needs called California Green Builder.

California Green Builder homes save 650 kWh of electricity each year, 20,000 gallons of water, reduce construction waste by a minimum of 50%, and use 100% certified sustainable forest products. When quantified in this manner, it is easy for jurisdictions to see the value of a California Green Builder home.

In addition, if built to Building America near-Zero Energy Home standards the homes will reduce green house gases between 40-70 percent. Residential housing accounts for over 20% of U.S. carbon emissions<sup>6</sup>, consequently 40-70 percent reductions are substantial.

The benefits most valued by local jurisdictions from green near-ZEHs are reduced construction waste going to local landfills, reduced resource demand in the form of natural gas, electricity, and water during the home's operation, and reduced green house gas emissions during home's operation. The local jurisdiction's needs and resources determine the value assigned to each of these activities.

## 4. EXAMPLES OF COST SHARING AND LEVERAGING BENEFITS OF ZEHS FOR STAKEHOLDERS

In most parts of the country the cost of building Zero Energy Homes falls on the builder and the homebuyer, to the extent the homebuyer is willing to pay. One of the reasons California has had success in constructing green and Zero Energy Homes is a result of incentives and solar buy-downs. A new program aims at recognizing the benefits of

energy and peak electricity saving homes through financial incentives.

The New Solar Homes Partnership is a California Energy Commission (CEC) managed program under the larger California Public Utilities Commission's Go Solar Initiative. The New Solar Homes Partnership (NSHP) is a \$350 million program aimed at creating a sustained solar market for new homes. As part of the Go Solar Initiative, the NSHP aims at incorporating solar power into 50% of all new homes built in California by 2020. The program will change the way solar incentives are allocated in all Independent Service Operator (ISO) areas.

The program begins a new era of state solar support with the inclusion of energy efficiency requirements for all new solar homes. Rob Hammon, of the BIRA, and Principal of ConSol, co-chaired the CEC NSHP Advisory Committee. Dr. Hammon communicated the concept that homes be equipped with all cost-effective energy efficiency measures before more expensive solar energy is added. The Premier Gardens case study provides proof, with real utility data, that combining energy efficiency with solar is the most cost-effective way to reduce homes' energy consumption, utility bills, and peak electricity demand.

NSHP offers two tiers based on energy efficiency performance. The first tier requires a 15% increase in efficiency over California's Title 24 to receive incentives. The second tier requires a 35% improvement above Title-24 building code, and a 40% improvement above cooling requirements, which corresponds to the performance achieved at the Premier Gardens community. The second tier allocates more financial incentive for energy efficiency and solar improvements. Both tiers require third party inspections to verify proper orientation, absence of solar shading, and high performance building features. The solar electric systems must be oriented to the south or west to maximize peak electricity production. The program design was influenced by Dr. Hammon, based on Building America's research findings from analyzing utility data at Premier Gardens and Cresleigh Rosewood. BIRA's research, relying on electric and natural gas bill data provided by the Sacramento Municipal Utility District (SMUD) and Pacific Gas and Electric (PG&E), validated the cost effectiveness of energy efficiency measures, the peak reducing capacity of near-Zero Energy Homes, and the practicality of achieving south and west facing PV systems on all homes in typical production community layouts. All three of these research findings directly influenced California's new program design and acceptance. NSHP homes will be energy-efficient, cut peak electricity use, and serve as model to emulate up and down the state and across the country.

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<sup>6</sup> Emissions of Greenhouse Gases in the United States 2002. DOE/EIA-0573(2002). Energy Information Administration, U.S. Department of Energy. October 2003.

The California Green Builder program has had success engaging jurisdictions to offer incentives to help builders pay for the benefits the jurisdictions receive.

In 1999, the Building Industry Institute initiated a program called the Community Energy Efficiency Program (CEEP). It worked with jurisdictions to encourage incentives for building 15% above California's Title 24 energy code. Over 20 jurisdictions signed up with incentives including expedited entitlement and permitting, a single-point of contact within the building department for builders, priority field inspections, builder recognition, and deferred or waived fees. This program has been modified to work with the California Green Builder program offering a wider array of benefits.

Many of the incentives are non-financial, but developers and builders spend a tremendous amount of money to buy land and build homes. The faster the developer and builder can sell homes, the less money they will spend on interest for land and construction loans.

This is one example of cost sharing between stakeholders. It is in the interest of the local jurisdiction to build homes that reduce stress on their local infrastructure and resources. Through incentives, jurisdictions can promote responsible building practices and save money.

## 5. PUTTING THE PIECES TOGETHER

TABLE 3: Who Benefits, and Who Pays for a Zero Energy Home?

Moving forward it will be essential that the developers and builders of green near-Zero Energy Homes receive incentives to build homes in ways that benefit all stakeholders. As shown in Table 3, the benefits of community scale green near-Zero Energy Homes reach far past the homeowner. For this reason, it is essential that these benefits be marketed to the appropriate stakeholders or the cost burden of green near-Zero Energy Homes will be placed on the builder and homeowner.

As evidence mounts supporting the impact green near-ZEHs have on utilities and local jurisdictions, builders and developers will be able to market these benefits to jurisdictions and utilities. Without proper stakeholder engagement, the benefits of green near-ZEHs will be only realized if marketable to homeowners.

## 6. CONCLUSIONS

This paper serves to highlight the benefits that green near-Zero Energy Homes offer homebuyers, homebuilders, electric utilities, and local jurisdictions. More work must be done to encourage better communication and education of all stakeholders to arrive at appropriate cost-sharing. If developers and builders can successfully market the proven benefits of green near-Zero Energy Homes they will become commonplace.

## 7. ACKNOWLEDGMENTS

It should be noted that none of this research nor shaping of the NSHP would be possible without the bold leadership of

<b>Moving Past Rebates and Buy-downs, Making a Business Case for Zero Energy Homes</b>		
<b>Stakeholder</b>	<b>ZEH Benefit</b>	<b>Stakeholder Payment</b>
<b>Electric Utility</b>	* Verified Peak Electricity Reduction (50%-100%) * Less impact on stressed infrastructure	* Rates and Tariffs that incent less consumption, and peak avoidance * Builder incentives that encourage EE and Solar (Like the NSHP)
<b>Local Jurisdictions</b>	* Reduced impact on city infrastructure - 20,000 gallons of water savings per home - 50% to 80% diversion of construction waste for recycling - 40% to 70% less energy consumption & GHG emissions	* Expedited Entitlement and Permitting * Single point of contact in Building Dept * Priority Field Inspections * Delayed or waived fees
<b>Builder</b>	* Differentiation, Increased Publicity, Industry Recognition, Faster Sales, Added marketability of ZEH features	* Builder pays for marketing benefit
<b>Homeowner</b>	* Reduced utility bills, added comfort, improved indoor air quality, environmental stewardship	* Homeowner pays more upfront for ZEH, but realizes positive monthly cash flow
<b>State/Nation's Citizens</b>	* Environmental and other large scale benefits (Waste, Water, Energy & Resource Conservation)	* RECS to builder * Federal Tax Breaks and Incentives
<p><b>The added costs of a Zero Energy Home, when shared among stakeholders who gain from it's value, can be small compared to the value it provides. The value distribution will be different in each ZEH community, therefore it is important to understand who gains and by how much to properly allocate costs and ultimately determine cost-effectiveness.</b></p>		

SMUD. Additionally, the leadership and technical assistance from the U.S. Department of Energy and the National Renewable Energy Laboratory were critical to this Zero Energy Home Case Study. BIRA would like to thank our partners Premier Homes, SMUD, PG&E, GE, and RAND for making all this possible.

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